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ABSTRACT

Programs which provide income maintenance to disabled persons of working age are experiencing rapidly growing enrollments and rising costs. Changes in the definition of disability are thought to be a contributing factor. A review of existing income programs for the work-disabled indicated that social and economic factors were used increasingly in disability determinations. In this study, five factors (functional limitation, age, occupation, sex, and education) were selected for study of their importance to lay persons in the definition of disability. College students (N=108) assigned levels of disability benefits appropriate for fictional applicants for public assistance disability benefits described in vignettes. Subjects used a scale ranging from not eligible to eligible for permanent lifetime benefits. The study used a factorial design to examine the relative importance of the five factors. Four of the five factors studied were found to exert important independent influences on the determination of disability. Functional limitation was of greatest importance, followed by age, occupation, and education. Sex had no significant impact. These results support the view that lay opinion sees disability as a condition defined by factors other than functional limitation. Further research might examine other factors which may also influence lay determinations of disability. (ABL)

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A Fractional Factorial Design Approach to Examining the Relative Importance of Five Factors in the Definition of Disability

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"A Fractional Factorial Design Approach to Examining the Relative Importance of Five Factors in the Definition of Disability"

Introduction

In the United States programs which provide income maintenance to disabled persons of working age have been experiencing rapidly growing enrollments and rising costs. (Berkowitz, Johnson et al, 1976) Reasons for this are not fully understood, but changes in the definition of disability, particularly growth in the importance of the non-medical components of the definition, are thought to be an important factor. Disability, like poverty and health, is a relative, socially defined state, the definition for which may be changing.

A review of existing income maintenance and income support programs for the work-disabled, and of proposals for change in these programs, indicates that in addition to functional limitation (the traditional medically defined criterion for disability), other social and economic factors are used increasingly in disability determinations. (Ortiz, 1981) However, there is no consensus as to the definition of disability, as illustrated by the enormous range of criteria and definitions used to define disability in the 85 public and private sector programs serving the disabled. (Berkowitz, Johnson et al, 1976) Definitions are not consistent even within the 15 federal programs which provide income transfers to the disabled. (Lawrence, Leeds, 1978) Functional limitation seems to be a criterion in all programs, but how it is measured varies a great deal. (Riley, Nagi, 1970; Kessler, 1970; Nagi, 1969; Slater, Vukmanovic et al, 1974) The Social Security Disability Insurance program considers age, occupational history, and education in cases

where the functional limitation alone is not severe enough to warrant a finding of disability. It has been difficult to establish objective standards for weighing these factors. (U.S. Congress, 1976)

It can be said that the assignment of disabled or non-disabled status is primarily a value judgement about conformity to social norms of well-being and role performance. (Slater, Vukmanovic et al, 1974) Use of non-medical criteria by income maintenance programs emerged from practical concerns about the employability of applicants for disability benefits. There is also evidence that individuals consider non-medical factors when they make the decision that they are disabled (signalled by applying for benefits). (Haber, 1973) Given equal functional limitations, older, less skilled, and less educated individuals are more likely to apply for benefits than are younger, more highly skilled and educated individuals. (Allan, 1976; Krute, Burdette, 1978; Lando, 1976)

Public policy toward income maintenance for the work disabled is undergoing critical review at present, from expert administrative, medical, and employment related perspectives, among others. It is also important to know for policy purposes how disability is perceived by the lay public, which is both the consumer and the source of financing for public income maintenance programs. Knowledge about lay values and norms regarding disability will help in designing programs acceptable to the public, which in recent years has been reluctant to increase or even maintain spending for social welfare services. This article reports on the development of a research instrument to measure the relative importance of several factors in the definition of disability, and in the results obtained from a sample of 108 college and university students.

Hypotheses

Five factors, functional limitation, age, occupation, sex, and education were selected for study of their importance to lay persons in the definition of disability. The study used vignettes describing fictional applicants for public assistance (unearned) disability benefits. The subjects were asked to assign the level of disability benefits which they felt was most appropriate for each vignette, using a five point scale ranging from "not eligible for benefits" to "eligible for permanent lifetime benefits." Three major questions were asked in this study, and five relationships were hypothesized.

Questions

1. Do the factors influence the assignment of disability benefits?
2. Which factors are most important in determining eligibility for benefits?
3. Are there any second order interactions which affect assignment of benefits?

Hypotheses

1. Eligibility for benefits is positively related to functional limitation.
2. Eligibility for benefits is positively related to age.
3. Eligibility for benefits is inversely related to occupational skills.
4. Eligibility for benefits is positively related to female sex.
5. Eligibility for benefits is inversely related to educational attainment.

Study Design

The study utilized an experimental design to investigate the effects of the five factors on the assignment of public assistance disability benefits to fictional applicants. The method used was a 3^5 factorial design (fractional factorial) in which five independent variables were manipulated in such a way that each was represented by three hierarchical levels. The number of cells possible in a 3^5 design is $3^5=243$. Using a fractional factorial design, this study made observations in a 1/3 fraction of the 243 possible cells (81 cells). This design allows for all the main effects and all but one of the first order (two-way) interactions to be estimated. The rationale for the use of fractional factorial designs comes from the theory of groups. (Finney, 1945) A factorial analysis of variance approach is called for with this design. (Cochran, Cox, 1957; Kempthorne, 1947)

Items

The items in this design were developed from the five factor recipe provided by each of the 81 cells. Each factor is represented by three levels, which form a hierarchy from least to greatest power. The levels for each factor were developed as follows:

Table 1 about here.

Eighty-one fictional case descriptions of applicants for disability benefits represented the various combinations and levels of the five factors.

Using the table above the exact contents for each scenario could be determined. For example:

Table 1

Levels of the Five Factors*

	Variable A	Variable B	Variable C	Variable D	Variable E
	Functional Limitation	Age	Occupation	Sex	Education
Level 0	restricted to sedentary activities	18-29	supervisory office worker	male	high school graduate or more
Level 1	walks with great difficulty with leg braces	30-54	skilled laborer	unspecified	4th to 8th grade education
Level 2	confined to wheelchair with limited use of arms and hands	55-64	unskilled laborer	female	less than second grade education

* The functional limitation variable did not include subjective states such as pain or psychological limitations because pretesting showed that the inclusion of these states made the variable too complex for subjects to agree on a hierarchy of severity.

Block 1, Unit 1 -- recipe: 00000

Functional Limitation -- 0 -- restricted to sedentary activities

Age -- 0 -- 18-29 years of age

Work History -- 0 -- supervisory office worker

Sex -- 0 -- male

Education -- 0 -- high school graduate or more

Scenario (Item #76 in actual instrument): Mr. S. is a man between the ages of 18 and 29. He has completed a high school education or more. Mr. S. is applying for benefits because he is restricted to sedentary activities. He was previously employed as a supervisory office worker.

Or: Block 3, Unit 7 -- recipe: 22221

Functional Limitation -- 2 -- confined to a wheelchair with limited use of arms and hands

Age -- 2 -- 55-64 years of age

Work History -- 2 -- unskilled laborer

Sex -- 2 -- female

Education -- 1 -- 4th to 8th grade education

Scenario (Item #42) in actual instrument): Ms. L. is a woman who has between a 4th and 8th grade education, and is applying for benefits because she is confined to a wheelchair with limited use of her arms and hands. She is between 55 and 64 years of age, and previously worked as an unskilled laborer.

Subjects

The subjects were 108 students enrolled in freshman and sophomore level courses at San Diego area colleges and universities. Volunteers were solicited by brief classroom presentations by the researcher

describing the purpose of the research. Participation was close to 100% in the classes approached.

The use of college students as a proxy for the general population is a very common practice, particularly with exploratory efforts and methodological studies. When this group is used there is always a need to be aware that responses may not be generalizable to the population in general. College populations are younger, in better health, have higher scores on intelligence tests and have more formal education than the rest of the population. Racial and ethnic minorities are under represented in college populations.

This study attempted to minimize the limitations to generalizability associated with use of college students by several methods. First, the majority of subjects were from a community college, a less elite institution than a four year college. Second, volunteers were solicited in required first and second year courses in order to obtain a cross-section of future majors. Third, descriptive data was collected on the subjects for comparison with characteristics of the general population.

Basic descriptive data was collected on each of the subjects so that the extent to which they represented a cross-section could be assessed.

The following descriptive information about the subjects was obtained. Forty-five (41.7%) of the subjects were male, and 64 (58.3%) were female.

The age distribution of the subjects is presented in the following table.

Table 2 about here.

Table 2

Age of Subjects

Age	Frequency	Percent
Under 18	11	10.2
18-22	44	40.7
23-29	36	33.3
30-49	14	13.0
60 and older	3	2.8
	108	100.0

The subjects over represented young adults compared to the total U.S. population, of which 29% is under 18 years of age, 28.7% is between 18 and 34 years of age and 42.3% is 35 and older. (U.S. Department of Commerce, 1980)

The subjects' religious affiliations are shown on the following table.

Table 3 about here.

The subjects compared well with national statistics on religion (based on church membership) which show 33% of the population Protestant, 23% Catholic, and 3% Jewish. (U.S. Department of Commerce, 1980)

The ethnic/racial composition of the subjects was 92 (85.2%) white persons and 16 (14.8%) minority individuals. The minority groups represented were five Hispanics, four Asians, three Blacks, two Native Americans and two others.

In comparison, U.S. Census statistics show 12% of Americans as black, 6% as Hispanic, and an additional 1% as other, non-white. (U.S. Department of Commerce, 1980)

With respect to political views, 10.2% (11) of the subjects reported that they were very conservative or somewhat conservative, 38% (41) reported their views were moderate, 48.1% (52) reported they were somewhat liberal or very liberal, and 3.8% (4) individuals reported their political views as radical or "other." One of the subjects reporting "other" saw himself as a radical/visionary. The other preferred not to involve himself in political matters.

Subjects were also asked about the presence of disabilities in themselves or family members. The majority, 75% (81) reported that neither they nor their families had any disabilities; 19.5% (21)

Table 3

Religion of Subjects

Religion	Frequency	Percent
Protestant	36	33.3
Catholic	29	26.9
Unaffiliated	26	24.1
Other	11	10.2
Jewish	6	5.6
	108	100.0

reported that they themselves, or a family member had a disability; only 5.6% (6) reported that both they and another family member had disabilities.

Presentation to Subjects

Instructions -- The instructions gave detailed information about how to complete the research instrument. Additionally, they were used to control extraneous variables which were not a part of the research design. These extraneous variables were:

1. cause of disability
2. prognosis for disability condition
3. applicant's pattern of employment/unemployment
4. type of disability benefit (earned or unearned)

The following paragraph provided the control over the first three of these factors:

> "You can assume that all the applicants are people who have been working steadily all their lives, from the time they completed their educations, until they became ill or were involved in the accidents which caused the present limitations. You can also assume that these people are not suffering from active disease at present. The impairments they report are permanent, and are not expected to get significantly better or worse in the future."

The fourth factor, type of benefit, was controlled by the following statement:

> "These people are applying for income maintenance (cash welfare payments from the government) to support themselves, stating that they are disabled and cannot work."

Scoring Instructions -- The scoring instructions provided a description of the type of eligibility for benefits represented by each of the five possible scores. The description represented a hierarchy from 1 -- "Not eligible for disability benefits" to 5 -- "Eligible for permanent lifetime disability benefits; No restrictions." The levels in between one and five represented increasingly generous benefits varying two factors, permanence of benefits and freedom from re-evaluation, and freedom from rehabilitation or work training requirements. Pretesting of the instrument had confirmed that these descriptions represented a hierarchy in the minds of potential subjects.

The Vignettes -- The 81 vignettes were developed as described above under Items. The scoring for each item was done by circling the correct number on the right hand margin of the page. The order of presentation of the vignettes was randomized once, and subjects received identical questionnaires so that each subject rated all of the 81 vignettes, creating a total N of 8748.

Results

A factorial analysis of variance approach was used for data analysis. One and two way analysis of variance obtained strong significance for four of the main effects, functional limitation ($F(2)=919.036$, $p < .001$), age ($F(2)=452.166$, $p < .001$), occupation ($F(2)=39.088$, $p < .001$), and education ($F(2)=17.068$, $p < .001$). The fifth factor, sex ($F(2)=1.236$, $p < .291$), was non-significant. Of the two way interactions, functional limitation and age was significant ($F(4)=3.309$, $p < .011$).

Table 4 about here.

Table 4

Summary of Results, 3^5 Fractional Factorial Design

N = 8748

Source of Variation	SS	df	MS	F	p level
Main Effects	2439.302	10	243.930	285.719	.001
Funct Limit	1569.239	2	784.620	919.036	.001
Age	772.067	2	386.033	452.166	.001
Occupation	66.743	2	33.371	39.088	.001
Sex	2.110	2	1.055	1.236	.291
Education	29.144	2	14.572	17.068	.001
2-way Interaction	33.516	40	.838	.981	.505
Funct Lim x Age	11.301	4	2.925	3.309	.011
Funct Lim x Occup	2.516	4	.629	.737	.567
Funct Lim x Sex	2.067	4	.517	.605	.659
Funct Lim x Educ	3.078	4	.769	.901	.463
Age x Occupation	2.796	4	.699	.819	.513
Age x Education	1.800	4	.450	.527	.716
Occupation x Sex	2.351	4	.588	.688	.600
Occupation x Educ	4.862	4	1.216	1.424	.224
Sex x Education	1.773	4	.443	.519	.722
EXPLAINED	2472.819	50	49.456	57.929	.001
RESIDUAL	7424.992	8697	.854		
TOTAL	9897.811	8747	1.132		

All main effects except sex are significant at the $p < .001$ level. The only significant interaction is that of functional limitation and age, which is $p < .011$.

Table 5 illustrates the results summarized above by showing the amount of variance accounted for by each of the significant factors.

Table 5 about here.

In Table 5, which shows the variance accounted for by each factor, we see that functional limitation has by far the most powerful effect accounting for 63.4% of explained variance as expected. Age is second in importance, accounting for 31.2% of explained variance. The main effects of these two factors together, then, provide 94.6% of the variance which is explained. The main effects of occupation and education are significant but much less powerful, accounting for 2.6% and 1.1% of explained variance, respectively.

Altogether the four significant factors explain 24.9% of total variance. The remaining 75% is within groups variance or error variance.

No higher order interactions were hypothesized or anticipated, however a small one did appear, involving interaction between functional limitation and age. It accounted for 0.4% of explained variance. Second and higher order interactions are not usually found in designs of this type.

Figure 1 provides a graphic representation of the mean responses for each level of the five factors. Table 6, which follows, provides the same information in tabular form.

Figure 1 and Table 6 about here.

Functional limitation and age exert the most influence on responses, work history and education are seen as less important, and the factor of

Table 5

Variance Accounted for by Each Factor

(Eta Squared)*

Source of Variation	SS	Percent of Total Variance	Percent of Explained Variance
Main Effects	2439.302	24.6	98.6
Funct Limit	1569.239	15.8	63.4
Age	772.067	7.8	31.2
Occupation	66.743	0.6	2.6
Education	29.144	0.2	1.1
2-way Interactions	33.516	0.3	1.3
Funct Limit x Age	11.301	0.1	0.4
EXPLAINED	2472.819	24.9	
RESIDUAL	7424.992	75.0	
TOTAL	9897.811	100.0	

*Due to rounding error the percentages shown do not equal 100.

Figure 1

Mean Response for Each Level of the 5 Factors

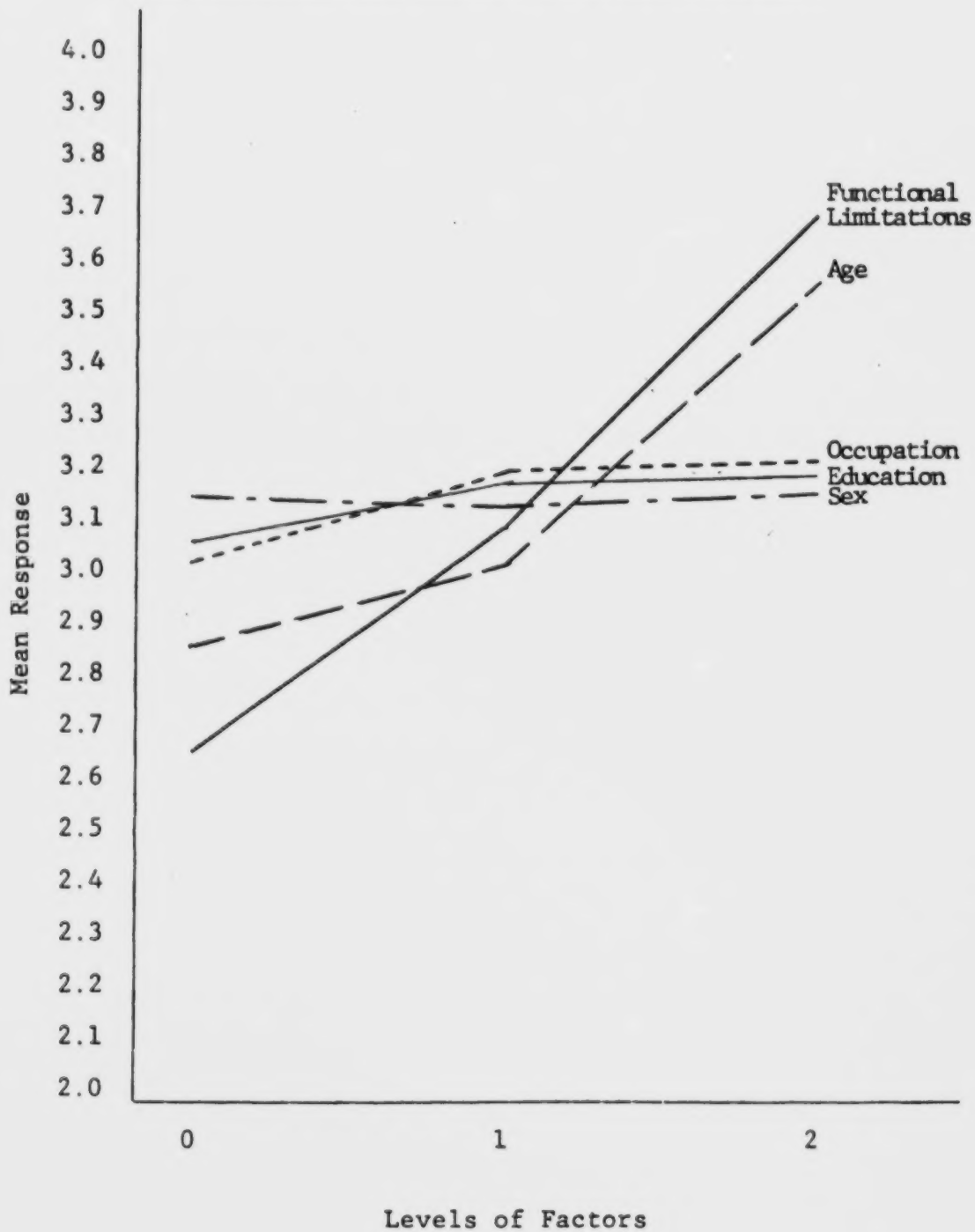

Table 6

Mean Response for Each Level of the 5 Factors

N = 8748

Factor	Mean Response Level 0	Level 1	Level 2
Functional Limitation	2.667	3.097	3.700
Age	2.866	3.034	3.563
Occupation	3.031	3.207	3.225
Sex	3.167	3.133	3.165
Education	3.073	3.194	3.196

sex has no significant impact on responses.

The interaction of functional limitation and age, which is minor compared to the strength of the main effects of each, seems strongest when older age and severe functional limitations are involved. Additionally, it can be seen that functional limitation and age are perceived as having three strongly different levels of severity, as shown by the vertical thrust of the graph. Occupation and education appear not to offer contrast between the second and third levels as shown by the small change in mean response and the relatively horizontal lines on the graph.

The Duncan Multiple Range Test was performed on the four factors for which significant main effects were found. The purpose was to establish if the means of the levels of the factors differed from each other at a statistically significant ($p < .05$) level. Table 7 shows the results of the Duncan procedures.

Table 7 about here.

We see that responses for functional limitation and age formed three significant subsets. The factors of occupation and age did not produce a statistically significant difference in responses to the second and third levels of the factors. This was noted also in Figure 1, where the lines for these factors are horizontal between the second and third factors.

Discussion

Results

Four of the five factors studied exerted important independent influences on the determination of disability. Functional limitation,

Table 7

Results of Duncan Multiple Range Test for 4 Factors

$p < .05$

Factors and Levels	Subset 1	Subset 2	Subset 3
Functional Limitation			
sedentary	2.6677		
leg braces		3.0971	
wheelchair			3.7003
Age			
18-29	2.8666		
30-54		3.0346	
55-64			3.5638
Occupation			
supervisory	3.0319		
skilled		3.2078	
unskilled		3.2253	
Education			
high school	3.0734		
4th to 8th grade		3.1948	
less than 2nd grade		3.1968	

the medically defined component of disability, was the most important factor in assigning benefits. The non-medical factors of age, occupation, and education, in descending order of importance, had an influence in determining eligibility. Sex had no significant impact on the assignment of benefits.

The results of the study support the view that lay opinion views disability as a condition defined by factors other than functional limitation. Rather than use a simple, functionally based criterion, this group of subjects made complex individualized judgements about applicants, using four different determinants. This finding supports the policy of the Social Security Disability Insurance program, which utilizes these factors in making determinations.

The hypothesis that female sex would be positively associated with eligibility for benefits was not supported. The rationale for the hypothesis was based on the fact that female recipients of disability benefits are on the whole less impaired than male recipients. There are many sex related differences in occupational and employment patterns. Some other sex-related aspect of labor force behavior may account for the lesser impairment of the female disabled.

Four of the five factors studied in this initial effort strongly influenced assignment of benefits. There may be other additional factors which also influence lay determinations of disability. Further research examining the influence of variables such as earned vs. unearned benefits, notions of cost in relation to benefit, and the effects of applicant demographic information on the granting of benefits is needed to explore lay opinion on this topic. The instrument developed for this study can be adapted to explore these additional factors.

Instrument

The research instrument, which contained 81 vignettes and 17 face sheet data questions, was considered a bit long to hold the subjects' attention. Some subjects complained that the vignettes became boring and repetitive after they were half-way through, but others reported they remained interested throughout the process of completing the instrument. Subjects reported spending as little as a half hour and as much as two hours rating the vignettes.

An additional area of concern is related to the levels assigned to the factors of occupation and education. The results of the Duncan Multiple Range Test ($p < .05$) shown in Table 7 revealed that these factors did not form three significant subsets. This means that the subjects did not differentiate to a significant degree between the occupational levels of skilled and unskilled labor, and the educational levels of 4th to 8th grade and less than second grade. This lack of differentiation may have weakened the main effects for these factors. The levels of the factors were selected to represent typical applicants for disability programs, who tend to have less education and be from lower skilled occupations than the general population. However, the compression of these factors into the lower levels may have artificially limited the subjects' range of choice. This problem will be addressed in future efforts.

The effect of sex was non significant in this study, but will be explored further in future efforts. There is statistical evidence (Allan, 1976; Krute, Burdette, 1978; Lando, 1976) that women report slightly higher rates of illness and disability than men, and that a higher proportion classify themselves as disabled. Possible

explanations for the differences are thought to be: sex related differences in application rates, eligibility, and beneficiary status in income maintenance programs for the work disabled. The larger issues of sex differences in labor force behavior generally, which shape the differences in income level, eligibility, and expectations which people bring with them to disability programs were not considered. It appears that the factor of sex as presented in this research effort did not elicit the desired complex of considerations from the subjects, and that further development of the instrument in this area is needed.

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